

# Unit II

## Research Methods: Thinking Critically With Psychological Science

### Overview

Psychology is defined as the scientific study of behavior and mental processes. While Unit 1 explored the origins of psychology and the contributions of early theorists and philosophers, psychology has evolved into a science-based, data-supported field. The empirical nature of the field is determined by the scientific method and the gathering of data to separate opinion and belief from demonstrable results. Unit 2 reviews the scientific method and the numerous research methods psychologists employ to study behavior and lays out the methodology and statistical reasoning that are modern psychology's underpinnings. Through the use of myriad examples, the distinction between beliefs and science is made clear.

### Modules

- 4 The Need for Psychological Science
- 5 The Scientific Method and Description
- 6 Correlation and Experimentation
- 7 Statistical Reasoning in Everyday Life
- 8 Frequently Asked Questions About Psychology

### Tip #2 Make Your Learning Fluid

Although your textbook and this accompanying study guide are arranged by "unit" and "module," the study of psychology is not easily segmented into parts. Psychology is a dynamic, ever-changing, and adapting science that overlaps and references all parts of life. As such, don't limit your understanding of a topic, theory, or key name to the sole chart you completed in Module 1, for instance. Throughout the course, when you can make a connection to previous content, return to that section and add a note or example. Keep YOUR learning fluid and unbound by unit or module distinctions. The more connections you make to previously learned material, the greater your recall of that material. This is called *elaborative rehearsal*, and we'll talk about that again in the Memory unit!

# Module 4

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## The Need for Psychological Science

### Before You Read

#### Module Summary

Module 4 lays the groundwork for future modules by pointing out the perception errors humans are known to make. The case is made for the use of empirical, science-based research to prove or disprove theories. A discussion of critical thinking ends the module.

Before beginning the module, take a moment to read each of the following terms you will encounter. You may wish to make vocabulary cards for each.

#### Key Terms

hindsight bias

critical thinking

### While You Read

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Answer the following questions/prompts.

4-1

1. Define hindsight bias.
2. Your text uses an example to illustrate hindsight bias: "After the football game, we credit the coach if a 'gutsy play' wins the game, and fault the coach for the 'stupid play' if it doesn't" (Myers, p. 31). How does this example illustrate hindsight bias?



## After You Read

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### Module 4 Review

Complete the questions below to see if you have mastered the basics.

Read the situations below and identify whether the phenomenon of hindsight bias (HB), overconfidence (O), or the tendency to perceive patterns in random events (P) is at work. Mark your answer in the blank.

- \_\_\_\_\_ 1. Toni notices that the last four times she has been to the grocery store she has scored a parking place right up front! She knows she is on a lucky streak!
- \_\_\_\_\_ 2. Bruce is often called a Monday Morning Quarterback by his friends for saying he knew the Redskins should have put the rookie wide receiver in last Sunday's game.
- \_\_\_\_\_ 3. Janelle, a senior in high school with a 3.0 GPA, is filling out her college applications. When asked by her friends and family what schools she is applying to and what schools she thinks she will get into, she lists Princeton, Yale, Harvard and Stanford and says she thinks she will get into all of them, except maybe for Harvard, which is her reach school.
- \_\_\_\_\_ 4. Shreya and Steve break up. Their classmate, Iram, tells her mother that she knew all along the two of them were not going to make it.
- \_\_\_\_\_ 5. Fiona, a student in your class, is certain the instructor does not like her. For the last three class sessions, the instructor has not called on her to answer a question, even though her hand was raised.

# Module 5

## The Scientific Method and Description

### Before You Read

#### Module Summary

Module 5 explains the process of moving from a theory to a hypothesis that is operationally defined and replicable. The module also introduces three descriptive research methods, the case study, naturalistic observation and surveys, and discusses the benefits and limitations of each. The module concludes by explaining the importance of selecting a random sample that represents the population being researched.

Before beginning the module, take a moment to read each of the following terms you will encounter. You may wish to make vocabulary cards for each.

#### Key Terms

theory	naturalistic observation
hypothesis	survey
operational definition	sampling bias
replication	population
case study	random sample

### While You Read

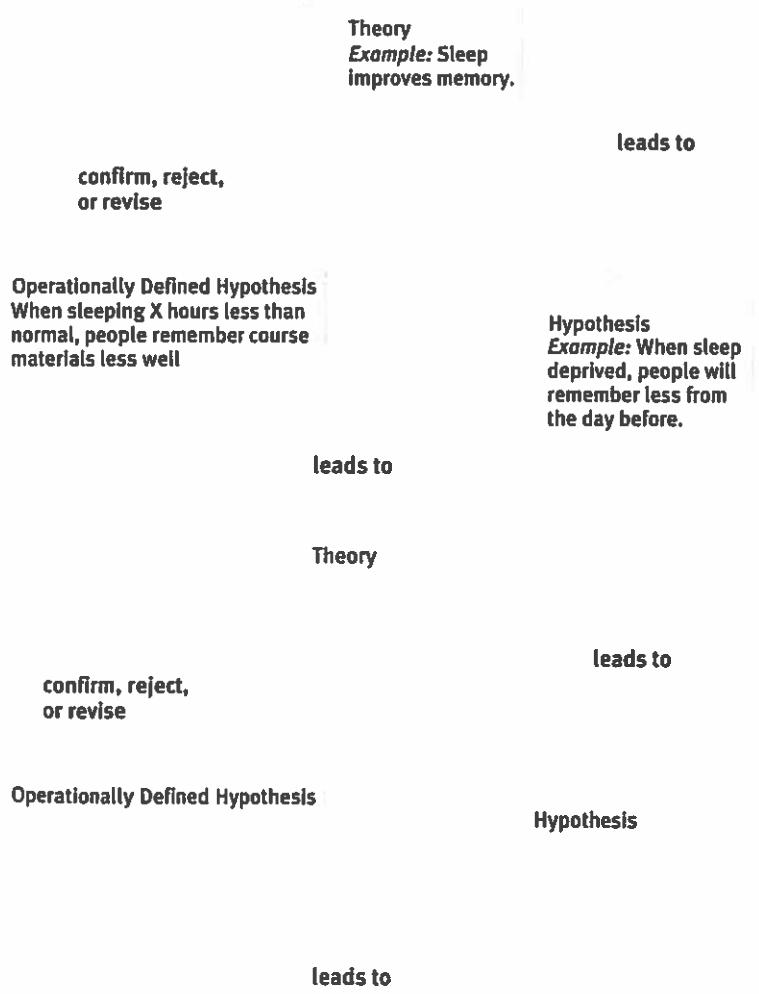
**5-1** Answer the following questions/prompts.

1. What is a theory? Give an example of a theory in your own life.
2. What is a hypothesis? Give an example from your own life of a hypothesis you might have.

3. Why is it essential to operationally define the variables in a study?

4. Why is replication so important in the research process?

5. David Myers presents the following example about the relationship between sleep and memory to show how a theory evolves into an operationally defined and replicable hypothesis. Study the text graphic, then test your understanding by filling in the blanks of the second graphic using the relationship between *smiling* and the *number of friends* people make.



Can you identify the independent variable (IV) and the dependent variable (DV) in these situations?

a. Sleep improves memory

IV:

DV:

b. Relationship between smiling and number of friends

IV:

DV:

**5-2**

Complete the following chart. One box has been filled in for you to get you started. Then, answer the questions that follow.

Descriptive Research Method	Benefits	Drawbacks	Key Characteristics
Case Study			
Naturalistic Observation		<i>Does not explain behavior</i>	
Survey			

1. Why are descriptive research methods limited in their ability to explain behavior?
2. How can the phrasing of a survey question affect the responses given by those surveyed?

3. How would you draw a random sample of participants if you were surveying:
- your high school classmates?
  - restaurant owners?
  - music listeners?

## After You Read

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### Module 5 Review

Complete the questions below to see if you have mastered the basics.

- Read the statements below and identify them as either a theory (T) or a hypothesis (H):
  - Caffeine reduces the risk of developing Alzheimer's disease.
  - When smoking cigarettes, teens are more likely to recall geometry proofs.
  - Increase in television viewing results in decreased attention.
  - Flu vaccinations increase the risk of developing the flu.
  - Dogs see in color.
- Read the following hypotheses and decide if there is an operational definition stated. If so, underline the operational definition.
  - Pregnant women who consume 150 mg of caffeine daily have an increase in blood pressure.
  - Dogs who overeat are more intelligent than those that do not.
  - Instructors who smile ten times in their class have increased student participation.
  - Students that break study sessions into five smaller 20-minute increments have higher grades on tests.
  - Teenagers that sleep in have greater resiliency in life.
- Read the statements below and decide which descriptive technique would be best utilized in each case: a case study (CS), naturalistic observation (NO) or survey (S). Write your answer on the blank.
  - A high school principal wants to determine whether she should use the building funds for a renovated student courtyard or a faculty exercise room.
  - An army doctor wants to see how soldiers are handling the transition back to civilian life.
  - A parent is curious to know how their child behaves when away from home at school.
  - An animal researcher wants to prove that squirrels run in packs as wolves do.
  - The school board in your town is trying to determine if teachers and students feel the building facilities are adequate and safe.



4. Identify the sampling flaw in the following three survey designs. Once you have identified the flaw, indicate you how would correct it.

a. The principal at a school wants to survey the students to see if they would like increased lunch time in place of one academic course. He gives this survey to the freshman PE teachers to hand out to their classes.

- flaw:

- correction:

b. A political campaign wants to poll potential voters to see how they feel about a candidate. They place calls to homes between the hours of 8:00 – 10:00 A.M. and again from 6:00 – 8:00 P.M.

- flaw:

- correction:

c. The mayor wants input from the community on the planned festivities for the upcoming 4th of July celebration. She places a survey of options in the community paper and lists the phone number for citizens to respond with their answers.

- flaw:

- correction:

# Module 6

## Correlation and Experimentation

### Before You Read

#### Module Summary

Module 6 adds correlation and experimentation to the list of research methods introduced in Module 5. The definitions and use of correlation coefficients and scatterplots are explained. The hazards of illusory correlations are pointed out and a thorough discussion of the experimental method is presented. The module concludes with a useful chart comparing and contrasting three of the primary research methods available to psychologists.

Before beginning the module, take a moment to read each of the following terms you will encounter. You may wish to make vocabulary cards for each.

#### Key Terms

correlation

correlation coefficient

scatterplot

illusory correlation

experiment

experimental group

control group

random assignment

double-blind procedure

placebo effect

independent variable

confounding variable

dependent variable

validity

### While You Read

Answer the following questions/prompts.

6-1

1. List two examples of a positive correlation between two variables. The first example should be from the text and the second example should be from your life.
2. List two examples of a negative correlation between two variables. The first example should be from the text and the second example should be from your life.

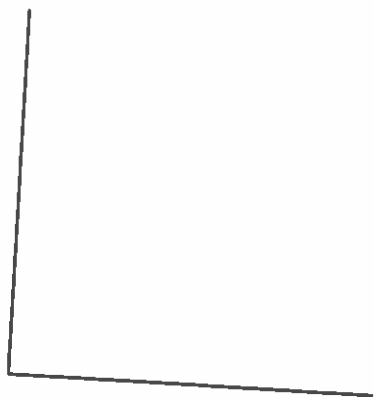
3. How is a scatterplot used to represent correlations between two variables?

4. The text author refers to a *New York Times* headline that states U.S. counties with high gun ownership rates tend to have high murder rates.

a. Is this a positive or negative correlation?

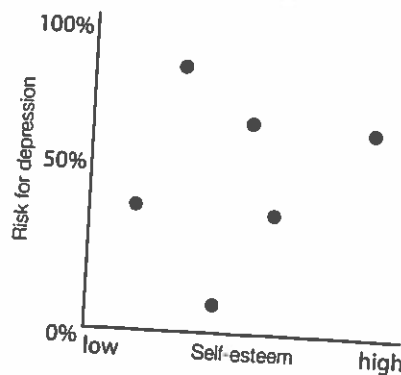
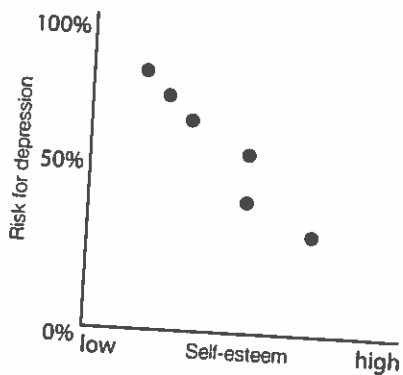
b. Why is the correlation positive or negative?

5. Draw a scatterplot below that would support your answer in #4. Be sure to correctly label the x- and y-axis.



6. The text states that self-esteem correlates negatively with depression.

a. Which of the following scatterplots could support that statement?



- b. Why?
- c. Based on the two scatterplots above, is it possible to say that low self-esteem causes depression? Why or why not?
- d. Based on the two scatterplots above, is it possible to say that depression causes low self-esteem? Why or why not?
- e. What point do you need to keep in mind regarding correlation and causation?

**6-2**

1. What is an illusory correlation? Give a real-life example of an illusory correlation.
2. Why should researchers (and people in general) be careful of illusory correlations?

**6-3**

1. David Myers presents two studies on the relationship between breast-fed babies and intelligence scores or social class. Working within that scenario, develop a hypothesis and show how the following terms would apply in an original experimental design that you create.
  - Hypothesis:
  - Experimental group:
  - Control group:

- Random assignment:
- Double-blind procedure:
- Placebo effect:
- Independent variable:
- Dependent variable:
- Confounding variable:

2. A high school track coach is interested in the impact of carbohydrate consumption on running times in her athletes. She asks half of her team to eat a huge pasta dinner the night before a big meet and asks the other half of her team to eat a large steak and no carbohydrates. Identify the variables in this experiment.

- Independent variable:

- Dependent variable:

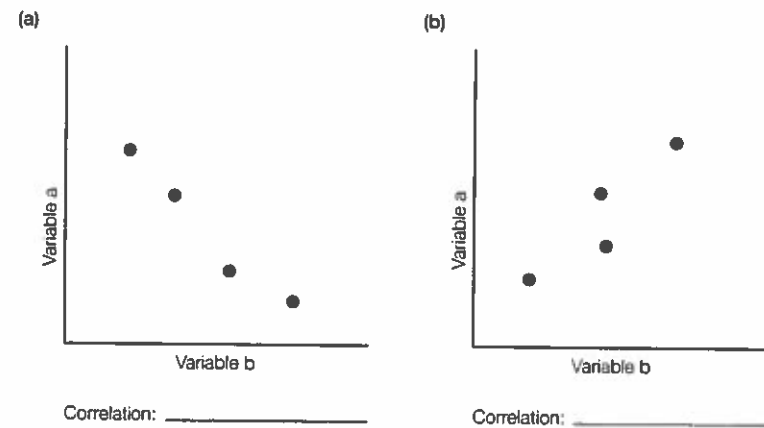
3. How do random sampling (from Module 5) and random assignment differ?

## After You Read

### Module 6 Review

Complete the questions below to see if you have mastered the basics.

- Read the pairs of variables below and predict whether the correlation would likely be positive (P) or negative (N):
  - \_\_\_\_\_ a. The number of fast food restaurants: the obesity rate in the U.S.
  - \_\_\_\_\_ b. The average U.S. household income: annual gross profit reported by U.S. retailers.
  - \_\_\_\_\_ c. The illiteracy rate: the presence of Head Start or early intervention education programs.
  - \_\_\_\_\_ d. The number of hours spent commuting to and from work; the amount of dinners cooked at home from scratch.
  - \_\_\_\_\_ e. Hours spent learning a skill; proficiency in the skill.
- Look at the scatterplots below and identify the correlation as positive (P) or negative (N).



- Which of the two scatterplots above has a strong correlation?
- If a straight line represents a correlation coefficient of 1 and a complete random pattern represents a correlation coefficient of 0, what would you estimate the correlation to be
  - in scatterplot (a)?
  - in scatterplot (b)?
- Give an example and an explanation of an illusory correlation in your life.

# Module 7

## Statistical Reasoning in Everyday Life

### Before You Read

#### Module Summary

Module 7 describes the three measures of central tendency and discusses the usefulness of the two measures of variation. The concept of statistical significance is explained and the criteria necessary to generalize experimental results is introduced.

Before beginning the module, take a moment to read each of the following terms you will encounter. You may wish to make vocabulary cards for each.

#### Key Terms

descriptive statistics  
mode  
mean  
median  
skewed distribution

range  
standard deviation  
normal curve  
inferential statistics  
statistical significance

### While You Read

Answer the following questions/prompts.

7-1

1. What are the three measures of central tendency, and what purpose does each of these measures serve?
2. Outliers, or extreme, "way-out" data that are significantly different from the majority of the data, have what effect on:
  - a. the mean?
  - b. the median?
  - c. the mode?

3. Define what the range for a set of scores is, and identify the range of the following set: 29, 39, 40, 52, 55, 80.
  
4. What does the standard deviation tell us?
  
5. What would a large standard deviation indicate?
  
6. What would a small standard deviation indicate?
  
7. Using Figure 7.3 from the textbook, write the percentage of scores on a normal curve that fall within one standard deviation. Next, write the percentages that fall within two and three standard deviations.
  
8. Now that you have been introduced to the basics of descriptive statistics, review the following calculations and practice with the sample data below.

7, 15, 20, 4, 8, 5, 4
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Measures of central tendency:

- a. Calculate the mean, median and mode of the data above.

mean \_\_\_\_\_ median \_\_\_\_\_ mode \_\_\_\_\_



☞ *Point to note:* The mean can be pulled in the direction of the outliers, so often the median is a better measure of central tendency.

☞ *Point to note:*

- If there are an odd number of data, the median will be the number in the middle after the data is arranged from highest to lowest.

2, 4, 6, 8, 10: 5 data points; median is 6

- If there are an even number of data, the median will be the mean (average) of the two middle numbers after the data is arranged from highest to lowest.

2, 4, 6, 8, 10, 12: 6 data points; mean is average of  $(6+8)/2$ , or 7

☞ *Point to note:* If more than one data point occurs with frequency, the data can be referred to as bimodal or multimodal.

Measures of variation: *How similar or diverse are the data?*

b. Calculate the range of the data. \_\_\_\_\_

☞ *Point to note:* When you take the highest number and subtract the lowest number, the result is the range.

c. Now find the standard deviation of the data, following the steps below.

1. Find the mean of your data
2. Find the difference between each number and the mean
3. Square each individual difference
4. Add up all of the squared numbers
5. Divide by the number of data points (This value is referred to as the variance. Variance is the average difference between individual data points in the distribution and the mean.)
6. Find the square root of the quotient from #5

You may use Table 7.1 from the text for reference (pg. 59) if you need help.

Data	Deviation from the mean	Squared deviation
7		
15		
20		
4		
8		
5		
4		
Mean of data:	Sum of squares:	

$$\sqrt{\frac{\text{Sum of squared deviations}}{\text{Number of scores}}} =$$

*Point to note:* In a way, this is rather like taking the average of the average—a better way to decide how different data points are from each other.

**7-2**

1. What is the difference between descriptive statistics and inferential statistics?
2. What are the three principles to keep in mind when deciding to generalize from a sample?
3. In the field of psychology, what is the standard for deciding if a result is statistically significant?
4. What does it mean if a result is statistically significant?

## After You Read

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### Module 7 Review

Complete the questions below to see if you have mastered the basics.

**3, 6, 6, 8, 9, 22**

1. Given the data set above, identify the
  - a. mean \_\_\_\_\_
  - b. median \_\_\_\_\_
  - c. mode \_\_\_\_\_
2. Which measure of central tendency should be used to most accurately describe the data above? Why?
3. Using the data set above, identify the
  - a. range \_\_\_\_\_
  - b. standard deviation \_\_\_\_\_

4. Assume a distribution of aptitude test scores forms a normal curve with a mean of 100 and a standard deviation of 15.
- Within which standard deviation will most of the scores fall?
  - If a student scores a 120, within which standard deviation will that score fall?
  - If a student scores within the second deviation, what is the possible range of the student's score?
5. Assume your class took a final exam in psychology in which the scores produced a normal curve with a mean score of 80 and a standard deviation of 5.
- 68% of the scores on the final exam would fall between \_\_\_\_\_ and \_\_\_\_\_.
  - If a student scores within two standard deviations from the mean, what is the possible range of the student's score?
  - What percentage of students may have scored either higher than 90 or lower than 70?

# Module 8

## Frequently Asked Questions About Psychology

### Before You Read

#### Module Summary

Module 8 discusses the ethical issues that confront experimental researchers and offers guidelines that promote ethically sound experimentation. Additionally, the influence of culture on our behavior and mental processes and the application of experimental research across culture and gender is presented.

Before beginning the module, take a moment to read each of the following terms you will encounter. You may wish to make vocabulary cards for each.

#### Key Terms

culture

informed consent

debriefing

### While You Read

As you read Module 8, answer the following questions/prompts.

8-1

1. According to the text, what is the purpose of an experiment?
2. Psychological science focuses less on \_\_\_\_\_ than on seeking general principles that help \_\_\_\_\_ many behaviors.
3. What is meant by the statement you completed in #2?

8-2

1. What are WEIRD cultures?
2. Why does the text author bring up the topic of WEIRD cultures?
3. How does a collectivist culture differ from an individualist culture?
4. How do you think the text author's use of the image of Burkina Faso boys playing soccer on page 65 helps emphasize that behavior depends on one's culture?

8-3

1. Why do psychologists study animals?

2. What are the two issues the text author suggests arise from the debate on animal experimentation?

3. How have animals themselves benefitted from animal research?

8-4

1. List and define the four ethical principles discussed in this section.

8-5

1. According to the text author, is psychology free of value judgments? What examples are used in the text to support his contention?

2. Why do you think the text author included this section in this module?

## After You Read

### Module 8 Review

Complete the questions below to see if you have mastered the basics.

Read each situation below and decide which ethical guideline is not being followed. Mark your answer(s) in the blank. More than one answer may apply.

Informed Consent (IC)  
Protection from physical or emotional harm (H)  
Confidentiality (C)  
Debriefing (D)

- \_\_\_\_\_ 1. A teacher in your school gives you a mandatory anonymous drug use survey to complete in class and tells you she cannot let you know why you are completing the survey because it would throw off her results.
- \_\_\_\_\_ 2. You agree to participate in an experiment that is designed to measure your ability to lie in various circumstances. Under the direction of the researcher, you make false statements to your mother, your best friend, and your favorite teacher. The guilt you feel after lying to these influential and important people has you questioning your morals and values.
- \_\_\_\_\_ 3. A psychologist in your town is invited to speak at career day at your school. You have been seeing the psychologist for more than a year for depression and attempted suicide. At career day the psychologist speaks of working with teen patients who are depressed and have attempted suicide and cites a few examples of his cases. Although he uses no names, you feel he is talking about you and run from the room embarrassed.
- \_\_\_\_\_ 4. At the conclusion of a study testing memory and mood, you are released by the researcher, paid a small fee, and thanked for your time.
- \_\_\_\_\_ 5. You are appointed to serve on the Institutional Review Board (IRB) at the research university where you teach, and will be screening research proposals to safeguard participant's well-being. A proposal is presented in which a researcher will be gathering data on the correlation between divorce and alcohol use disorder in celebrities. The proposal lists the research methodology, the sample population, and the manner in which the results of the study will be communicated. The researcher intends to write an article for a journal in the field, and also publish the results of the study in an entertainment magazine. He feels that if people know the actual names of the participants, they may take the results more seriously and so he intends to list the names in the entertainment article.

**✓ Check Yourself**

Now that you have mastered the basics, work through the problems below to see if you can *synthesize* what you have learned.

A local botanist believes that the town water supply contains contaminants that are killing the native plant life. She intends to make her case to the Board of Supervisors at the next town meeting in two months but wants to have hard data to support her case. She decides to conduct an experiment to test her theory. She begins by collecting 10 plant samples from the local park and places all 10 plants in a roped-off square area that receives ample light and will be undisturbed by park enthusiasts. Next, she places 10 scraps of paper numbered 1 to 10 in a hat, then pulls the scraps of paper at random, numbers the plants 1 to 10, and divides them into two groups. For six weeks, she waters 5 of the plants (plants 3, 5, 7, 9, and 10) using the town water supply and 5 of the plants (plants 1, 2, 4, 6, and 8) using bottled, distilled water. During the six weeks, she asks her neighbor and fellow plant lover to keep records of leaf condition (color, texture, strength) and stem and root conditions by counting the number of yellowed spots, wilted leaves, and withered offshoots. At the end of six weeks, she asks her neighbor to evaluate the 10 plants and he reports that plants 3, 5, 9, and 10 are yellowed, withering, and diseased.

- a. What is the hypothesis in this situation?
- b. Which group of plants is the experimental group? The control group?
- c. What method did the researcher use to randomly assign the groups?
- d. How was a double blind procedure used?
- e. Was a placebo used? If so, what was it?
- f. What was the IV? The DV?
- g. What is the operational definition of the IV? The DV?
- h. What possible confounding variables might the researcher not have taken into account?
- i. Was this experiment valid? Why or why not?



## ✓ Check Yourself

Now that you have mastered the basics, work through the problems below to see if you can *synthesize*, *evaluate*, and *analyze* what you have learned.

An instructor in an AP® Psychology course is trying to evaluate and analyze his test data to better hone his teaching methods and style to meet the needs of his students. After a quarter of collecting test data, the instructor has the following test averages for his 20 students:

89, 40, 82, 94, 93, 83, 73, 77, 49, 99, 78, 87, 86, 59, 90, 65, 60, 89, 73, 70

In order to help him assess his students' performance, he calls you, a psychometric statistical psychologist, to help him analyze the data and make a plan for improving his teaching. You compile the following data sheet to help the instructor with his goal.

Mean of the data:

Median of the data:

Mode of the data:

Range:

Variance:

Standard Deviation:

1. Based on the results of the data collection, how will you advise the instructor?
2. Which measure of central tendency should the instructor use to guide his analysis? Why?
3. How does the range and the standard deviation give you information to help advise the instructor?



## Before You Move On

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Use the checklist below to verify your understanding of the unit's main points.

Do I know the difference between the types of descriptive research?

- case studies
- surveys
- naturalistic observation

Do I know the purposes, benefits, and drawbacks to correlational studies and experiments?

Can I identify the components of an experiment?

- IV
- DV
- confounding variables
- control and experimental groups
- random assignment and random selection
- placebos
- experimenter bias

Do I know the difference between reliability and validity?

Do I know the importance of operational definitions in experimental research?

Do I know basic descriptive statistics?

- measures of central tendency
- range
- standard deviation

Do I understand the difference between descriptive and inferential statistics?

Do I know the ethical guidelines for conducting research on human and animal participants?